Feedlot Performance, Carcass Characteristics and Meat Palatability of Steers Fed Concentrate for Short Periods

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FEEDLOT PERFORMANCE, CARCASS CHARACTERISTICS AND MEAT PALATABILITY OF STEERS FED CONCENTRATE FOR SHORT PERIODS

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SUMMARY

Animal performance, carcass characteristics and meat palatability of steers fed a concentrate diet for short periods were evaluated. Forty steers (424 kg) from a forage study were assigned to four groups and three of the groups were switched to an 85% concentrate diet during a 5-day interval and then fed this diet *ad libitum* for 3, 6 or 9 weeks. Average number of days the steers were on experiment, including the dietary adjustment period, was 51.0, 27.5, 48.0 and 68.5 for treatments of 0, 3, 6 and 9 weeks of concentrate, respectively. Daily live weight gain was not different ($P>.05$) among treatments; however, the experimental periods were relatively short. Dressing percentage increased as the period of feeding concentrate increased. Calculated daily carcass gain was higher for steers fed concentrate than for those fed hay (.67 *vs* .36 kg, $P<.05$).

Length of the period that concentrate was fed did not affect lean color or texture but did increase ($P<.05$) the amount of marbling in the *longissimus* muscle at the 12th rib. Differences in marbling were reflected by differences in USDA quality grade. Length of the period that concentrate was fed had little influence on cooking properties of the meat or palatability as judged by a trained taste panel. Extractable lipid from the *longissimus* muscle increased, the relative percentage of stearic acid decreased and that of oleic acid increased as the period of feeding concentrate increased.
(*Key Words:* Feedlot Performance, Carcass, Meat, Beef Cattle.)

INTRODUCTION

Carcasses of cattle finished on forage generally grade lower than those finished on concentrate. Not only is there less intramuscular fat (marbling) within the meat of forage-finished cattle but the fat also tends to be more saturated (Oltjen and Dinius, 1975). Forage-finished beef may be less acceptable to consumers because of differences in color of either the lean or fat (Craig *et al.*, 1959) and because of differences in palatability characteristics (Bowling *et al.*, 1977; Schupp *et al.*, 1976).

In the present study steers that had been fed forage in the feedlot were then fed a high-concentrate diet for varying periods to evaluate animal performance and to determine whether carcass characteristics and meat palatability would differ from that of steers fed the forage diet.

EXPERIMENTAL PROCEDURE

Forty Hereford steers (avg weight, 424 kg) from a 105-day feedlot experiment with additives and a ground alfalfa hay diet (experiment 2 of Dinius *et al.*, 1978) were assigned to four groups to equalize weight and prior treatment. One group, selected at random, was fed the hay diet and the other three groups were fed an 85% concentrate diet (table 1). Samples of the diets were analyzed for crude protein by the Kjeldahl procedure (AOAC, 1976) and for fiber by the procedures of Goering and Van Soest (1970). Results of these analyses are given in table 1. The three groups were switched to the concentrate diet over a 5-day period and then fed *ad libitum* for 3, 6 or 9 weeks. After the designated period the steers were individually weighed, fasted for 24 hr, reweighed and slaughtered. Three or four of the steers fed hay were slaughtered the same week as each concentrate-fed group.

Final weight (table 2) was the average body weight before fasting, and average daily live weight gain includes the transition period from hay to concentrate diets for three groups. Shrink was the loss in live weight during the 24-hr fast with water available. Dressing percentage was calculated from shrunk live weight and chilled carcass weight. For daily carcass weight gain calculations, all steers were assumed to have the same shrink and dressing percentage at the beginning of the study as the average observed in the group fed hay throughout the study.

A section of the *longissimus* muscle at the 11th and 12th rib was removed from the carcasses following a 48-hr chill at 3 C and was frozen at −20

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TABLE 1. EXPERIMENTAL DIETS

Item	Internat'l Ref. No.	Hay	Concentrate[a]
		%	
Ingredient			
Alfalfa hay, US gr 1	1 00 063	96	...
Orchardgrass hay	1 03 438	...	15
Corn, grain, US gr 2	4 02 931	...	78.5
Molasses, sugarcane	4 04 696	...	5
Animal fat	4 00 409	3	...
Urea	...	...	.5
Monosodium phosphate	6 04 288	.5	...
Calcium phosphate	...	...	.5
Trace mineral salt	...	.5	.5
Composition of dry matter			
Crude protein	...	16.3	11.6
Neutral-detergent fiber	...	47.2	26.2
Acid-detergent fiber	...	37.6	11.2

[a]Supplemented with 2,000 IU of vitamin A and 300 IU of vitamin D per kilogram of diet.

C for subsequent sensory evaluation. Carcass characteristics, Instron shear force, cooking procedure, measurement of degree of doneness and trained sensory panel evaluation were monitored as described by Cross and Dinius (1978).

Cross sections of the *longissimus* muscle at the 12th rib were removed after a 48-hr chill and frozen at −20 C until processed for fatty acid analysis. For this analysis all subcutaneous and intermuscular adipose tissue was removed, the muscle sample was lyophilized, ground and extracted with ethyl ether. Extracted lipid was added to a .5% solution of concentrated sulfuric acid in methanol (V/V) for hydrolysis and methylation (Sink *et al.*, 1964). The individual fatty acid esters were determined by gas chromotography using a 1.8-m by 3.2- mm i.d. column packed with 20% diethylene glycol succinate on 60-80 mesh acid-washed chromasorb W coupled to a flame ionization detector. Each acid was calculated as a percentage of the total which included myristic through linolenic.

All data were statistically analyzed by least squares analysis of variance for a randomized block design (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

One steer of the group fed concentrate for 9 weeks became anorectic about a week after having been switched from hay to concentrate and was removed from the experiment. There were no differences ($P>.05$) in daily live weight gain (table 2) among treatments, but these data are tenuous because the experimental periods were relatively short and because gastrointestinal tract fill as a percentage of live weight most likely decreased for the three groups switched from hay to concentrate whereas that of steers continuously fed hay

TABLE 2. FEEDLOT PERFORMANCE OF STEERS FED CONCENTRATES FOR 0, 3, 6 or 9 WEEKS

Item	Weeks fed concentrate diet				
	0	3	6	9	SE
No. of steers	10	10	10	9	...
Initial weight, kg	423	424	424	424	...
Avg no. days on experiment	51	27.5	48	68.5	...
Final weight, kg	456	441	460	482	...
Feed intake, kg dry matter/day	11.4	10.6	11.1	12.1	...
Live weight gain, kg/day	.58	.65	.73	.85	.10
Chilled carcass weight, kg	251[a]	250[a]	267[a,b]	290[b]	8.6
Carcass weight gain, kg/day[d]	.36[a]	.59[b]	.67[b]	.74[b]	.08
Shrink[e], %	5.2[A]	3.5[B]	3.4[B]	1.7[C]	.4
Dressing percentage	58.2[a]	58.8[ab]	60.2[b,c]	60.8[c]	.6

[a,b,c;A,B,C], Means on the same row without a common superscript are different, $P<.05$ and $P<.01$, respectively.
[d]See text for method of calculating carcass gain.
[e]Live weight loss during a 24-hr fast.

probably changed little. Changes in fill will greatly effect apparent live weight gain but not carcass gain. Chilled carcass weight was directly related to days on feed. Calculated daily carcass gain was higher ($P<.05$) for steers fed concentrate than for those fed hay, and daily carcass gain tended to increase as the period of feeding concentrate increased. However, the transition period from hay to concentrate, when carcass gain may have been low, was a greater proportion of the total experimental period of steers fed concentrate for 3 weeks than for those fed concentrate for 9 weeks.

Shrink (table 2) during the 24-hr fast was greatest ($P<.01$) for steers fed hay and least for steers fed concentrate longest. The reason for the difference in shrink among the three groups fed the concentrate diet is uncertain, but shrink of steers fed concentrate for 9 weeks was unusually low. Dressing percentage increased ($P<.05$) as the interval of feeding concentrate increased.

Length of the period that concentrate was fed did not affect lean color, texture or firmness (table 3). These results agree with those of Reagan *et al.* (1977) who reported no initial difference in surface coloration of steaks from cattle fed grass or grass and grain. They did report more discoloration in steaks from cattle fed only grass of meat kept in a display case then in steaks from cattle fed the grass-grain combination. The number of days concentrate was fed increased ($P<.05$) the amount of marbling at the 12th rib (table 3). Steers fed concentrate for 9 weeks had more ($P<.05$) marbling than steers fed concentrate for 0 or 3 weeks (small + *vs* slight +). These differences were also reflected by differences in USDA quality grade. In this study cattle fed concentrate for 9 weeks produced carcasses that graded US Low Choice whereas the remainder graded Good. With a normal market spread between Choice and Good of $2 to $6 per cwt, this grade difference could be economically important. Oltjen *et al.* (1971) reported no difference in marbling between steers fed a dry forage diet for 168 days and those fed a grain diet the latter 84 days of the 168-day experiment. Grain feeding, however, improved carcass quality one-third of a grade in that study whereas it improved carcass quality two-thirds of a grade in the present study.

Fat deposition increased with the length of the period that cattle were fed concentrate as evidenced by increases in fat thickness, percentage of kidney, heart and pelvic fat and USDA yield grade. The highest mean yield grade (higher grade indicates fatter cattle) was 3.3; therefore, waste fat was not excessive. All carcasses had moderately white fat; and even though a difference existed ($P<.05$) between treatments, the difference was between steers fed concentrate for 6 or 9 weeks and thus appears to be random variation. A previous report (Schupp *et al.*, 1976) indicates that few consumer problems exist with fat color ratings in the range observed in this study.

Although the length of the period that concentrate was fed influenced carcass composition (table 3), few differences or trends were detected in cooking or palatability characteristics (table 4). Degree of doneness, tenderness, juiciness and connective tissue were similar among all

TABLE 3. CARCASS CHARACTERISTICS OF STEERS FED CONCENTRATES FOR 0, 3, 6 or 9 WEEKS

Trait	Weeks fed concentrate diet				SE
	0	3	6	9	
Lean color[a]	4.1	4.4	4.2	4.4	.2
Lean texture[b]	5.2	5.6	5.2	5.2	.2
Lean firmness[c]	4.7	5.2	4.6	4.9	.2
Marbling amount[d]	12^{g}	12^{g}	$14^{g,h}$	15^{h}	.7
USDA quality grade[e]	17^{g}	17^{g}	$18^{g,h}$	19^{h}	.3
Fat thickness, cm	$.8^{g}$	$.9^{g,h}$	$1.0^{g,h}$	1.2^{h}	.1
Ribeye area, cm^2	9.4	9.9	9.9	10.5	.3
Estimated % kidney, heart and pelvic fat	1.9^{g}	$2.2^{g,h}$	2.4^{h}	2.5^{h}	.1
USDA yield grade	$2.9^{g,h}$	2.7^{g}	$3.1^{g,h}$	3.3^{h}	.2
Fat color[f]	$2.9^{g,h}$	$2.9^{g,h}$	2.6^{g}	3.2^{h}	.2

[a]Lean color: 7 = dark pink, 1 = very dark red.
[b]Lean texture: 7 = very fine, 1 = extremely coarse.
[c]Lean firmness: 7 = very firm, 1 = extremely soft.
[d]Marbling amount: 11 = slight, 14 = small.
[e]USDA quality grade: 17 = good, 20 = choice.
[f]Fat color: 1 = yellow, 5 = white.
[g,h]Means on the same row without a common superscript are different ($P<.05$).

TABLE 4. COOKING AND PALATABILITY CHARACTERISTICS OF RIBSTEAKS FROM STEERS FED CONCENTRATES FOR 0, 3, 6 or 9 WEEKS

Trait	Weeks fed concentrate diet				
	0	3	6	9	SE
Degree of doneness[a]	3.3	3.3	3.6	3.3	.3
Total cooking loss, %	34.8[e]	26.4[f]	25.8[f]	35.9[e]	4.1
Tenderness[b]	3.9	4.5	4.6	4.5	.3
Juiciness[c]	5.1	5.3	5.4	5.4	.3
Connective tissue[d]	4.0	4.3	4.4	4.2	.4
Instron shear force, kg	8.5	7.6	6.8	7.1	1.2

[a]Degree of doneness: 8 = rare, 1 = well done.
[b]Tenderness: 8 = extremely juicy, 1 = extremely tough.
[c]Juiciness: 8 = extremely juicy, 1 = extremely dry.
[d]Connective tissue: 8 = none, 1 = abundant.
[e,f]Means on the same row without a common superscript are different ($P < .05$).

TABLE 5. ETHER EXTRACTABLE LIPID AND RELATIVE PERCENTAGES OF LONG-CHAIN FATTY ACIDS IN THE *LONGISSIMUS* MUSCLE

Lipid	Weeks fed concentrate diet				
	0	3	6	9	SE
Intramuscular lipid[a]	12.5[b]	11.2[b]	15.8[b,c]	19.5[c]	1.8
Fatty acid					
Myristic	2.8[b]	2.6[b]	3.0[b]	3.7[c]	.2
Myristoleic	.8[b]	1.0[b]	.9[b]	1.4[c]	.1
Palmitic	29.4	28.1	28.2	27.7	.5
Palmitoleic	3.6	3.5	3.5	3.7	.2
Stearic	19.4[b]	18.9[b,c]	17.5[c]	15.2[d]	.6
Oleic	40.1[b]	43.0[c]	43.2[c]	44.7[c]	.7
Linoleic	2.5	2.4	2.5	2.9	.2

[a]Percentage of intramuscular lipid in dried *longissimus* muscle.
[b,c,d]Means on the same row without a common superscript are different ($P < .05$).

treatments. Although there were differences ($P < .05$) in total cooking losses among treatments, these differences were not related to the number of weeks the concentrate diet was fed. Bowling *et al.* (1977) also found no differences in degree of doneness, juiciness or cooking loss between meat from steers fed forage and meat from those fed grain. They did, however, find less connective tissue and greater overall palatability with meat from steers fed grain.

Data for extractable lipid and long-chain fatty acids in the *longissimus* muscle are given in table 5. Whereas feeding concentrate for 3 weeks did not influence total extractable lipid, feeding concentrate for 9 weeks substantially increased ($P < .05$) extractable lipid. This increase was also reflected in the ratings for marbling amount (table 3). The relative percentage of stearic acid decreased and that of oleic acid increased as the length of the period of feeding concentrates increased. Such differences in fatty acid composition related to diet have been previously reported (Oltjen and Dinius, 1975), and are generally related to the proportion and amount of volatile fatty acids produced by microbial fermentation of the different diets. The changes in fatty acid composition (table 5) had no discernible effect on palatability characteristics (table 4) of the cooked meat.

Cattle gained carcass weight rapidly when shifted to the concentrate diet, and such economically important traits as dressing percentage and quality grade were improved by feeding concentrate. Quality measures of lean tissue and taste panel evaluation of the meat were expected to improve with concentrate feeding but did not.

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